CERTS Microgrid Test Bed

Phase III Activities

Role of Microgrids in Facilitating Integration of Distributed Renewable Electricity Sources

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Impacts and Benefits

Microgrids can enhance the values that DER offer:

Customer benefits include: bill savings, price certainty, reliability (including power quality), independence

Grid benefits include: a well-behaved electrical “citizen”

Societal benefits include: more resilient local energy infrastructure, possibly also environmental benefits

The CERTS Microgrid Project is recognized internationally as one of the leading microgrid R&D activities

Microgrids vs. CERTS Microgrids

"A **microgrid** is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode "

Microgrid Exchange Group. October 2010

Distinguishing features of the **CERTS Microgrid *Concept***

- Seamless islanding and reconnection via single PCC
- Peer-to-peer, autonomous coordination among micro-sources (w/o high bandwidth communications)
- Plug-and-play - no custom engineering
- Energy manager on arbitrary platform

Distinguishing features of the **CERTS Microgrid *Test Bed Demonstration***

- Small sources (<100 kW each)
- No stand-alone storage (yet)
- No power flow onto the grid

CERTS Microgrid R&D Timeline

DOE Transmission Reliability Program – 1999-2002

- Development of the original CERTS Microgrid concept
- Simulation and bench-scale testing
- Assessment of potential test bed sites
- Creation of enabling software tools (DER-CAM, mu-Grid)

CEC PIER Energy Systems Integration Program – 2001-2006

- Construction of AEP CERTS Microgrid test bed
- Completion of proof-of-concept CERTS Microgrid tests

DOE Renewables and Distribution System Integration Program – 2006-2010

- Value and technology assessments to enhance the business case

DOE Smart Grid R&D Program – 2010-present

- Integration of storage and variable renewable generation

Technical Approach for Phase III

GENERALIZED TECHNICAL APPROACH

Analysis -> Detailed Simulation -> Bench-Scale Testing -> Prototype Specification -> Factory/Field Acceptance Testing of Prototypes -> Component and Full System Tests at AEP CERTS Microgrid Test Bed

KEY ELEMENTS OF TECHNICAL APPROACH FOR PHASE III

Mechanical switch – Install mechanical switch; repeat tests conducted with static switch

Synchronous generator – Acquire a synchronous generator; implement CERTS control algorithms in governor controls; conduct component and system tests at AEP

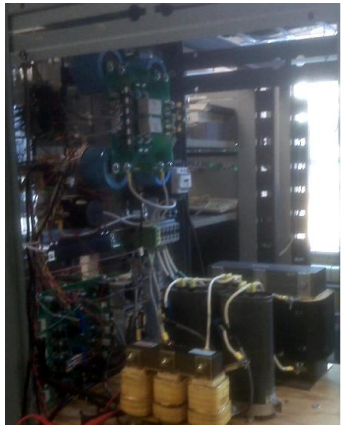
Energy management – Build an interface between AEP test bed and DER-CAM; use information from DER-CAM to support intelligent load-shedding

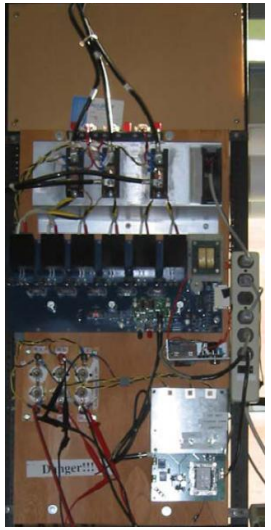
Intelligent load shedding – Install under-frequency relays with adjustable settings for amount of load shed, frequency trip points, and delay times; conduct system tests at AEP

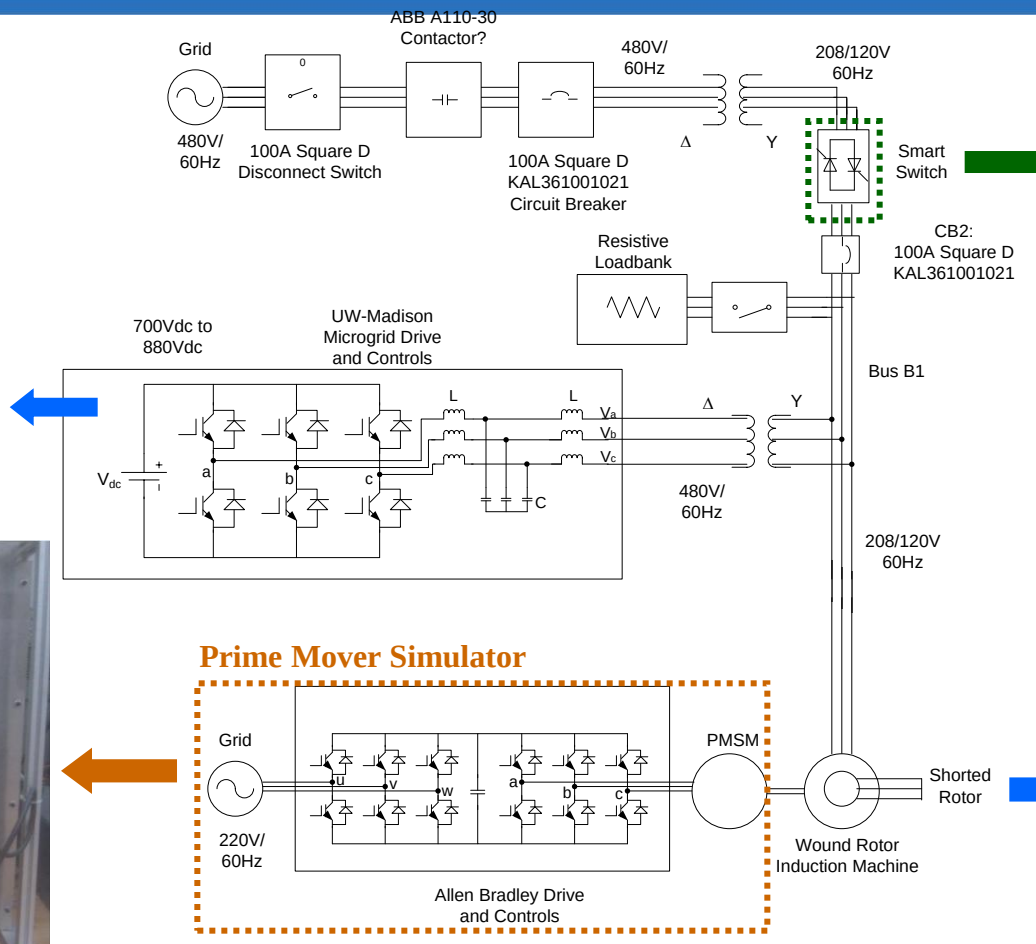
Storage – Install a conventional storage system (lead-acid batteries); implement CERTS control algorithms; conduct component and system tests at AEP

PV – Acquire a PV emulator; implement CERTS control algorithms; conduct component and system tests at AEP

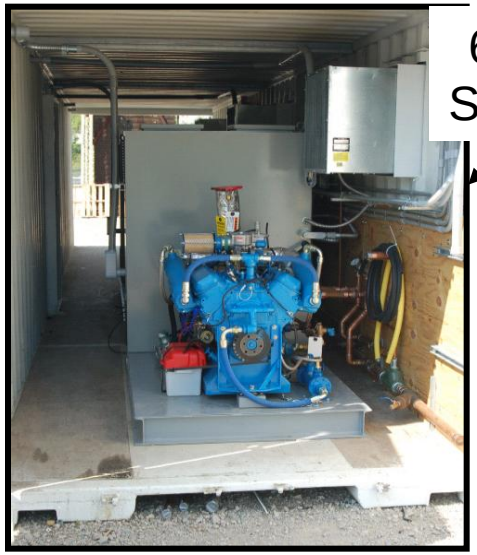
Bench-Scale Test Bed at UW



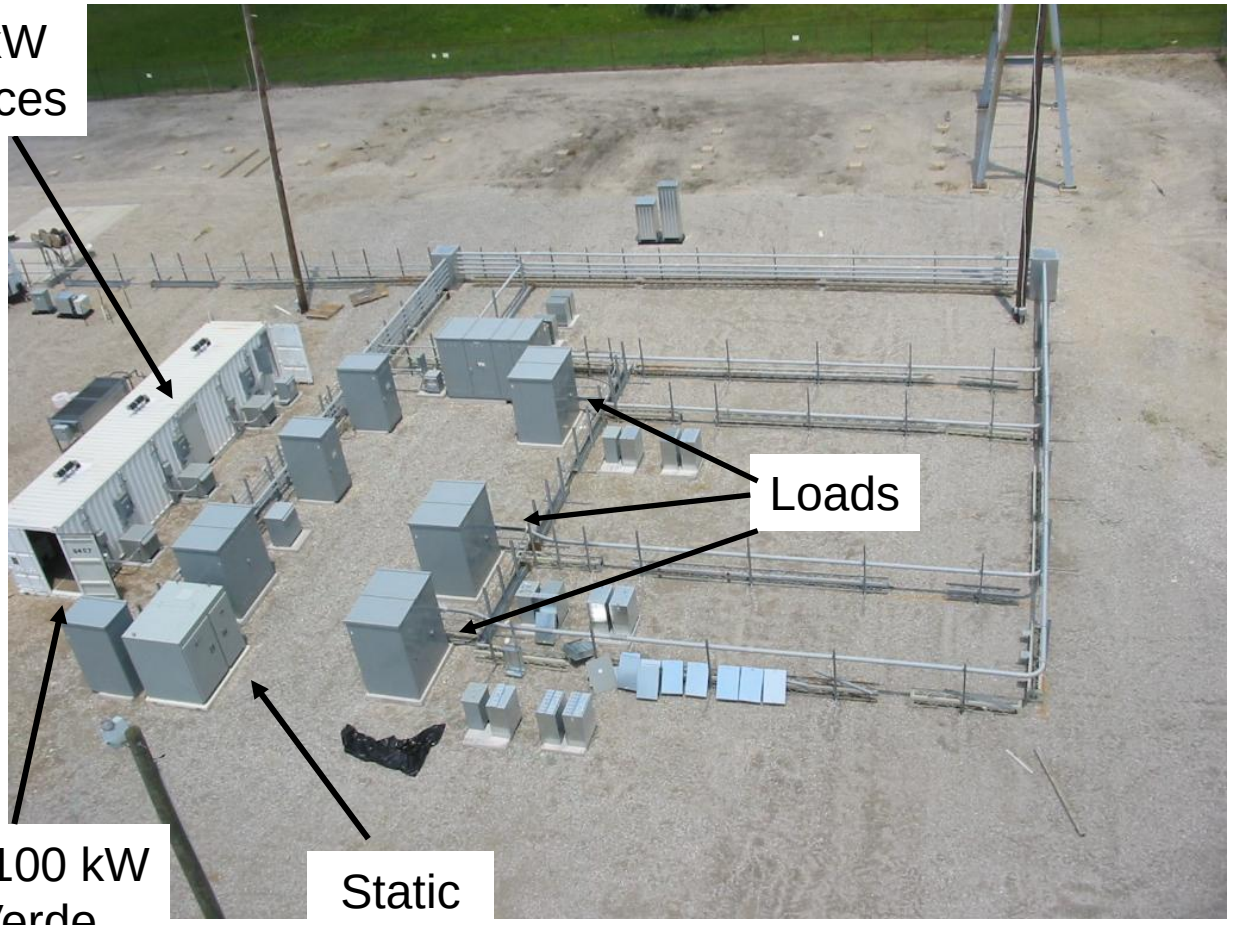




AEP/CERTS Microgrid Test Bed



60 kW Sources



Loads

New 100 kW InVerde

Static Switch

Interactions & Collaborations

The CERTS Microgrid Project Team consists of:

- Lawrence Berkeley National Laboratory
- University of Wisconsin
- American Electric Power Company
- Sandia National Laboratories

The research partners currently include:

- Tecogen
- The Switch (inverter manufacturer)
- Woodward/PowerSecure

Project Team members are involved in a number complementary activities

- SMUD microgrid field demonstration
- Chevron microgrid field demonstration at Santa Rita Jail
- Maxwell Air Force Base microgrid demonstration
- International Microgrid Symposium

In addition the project team is in discussions with a wide variety of potential field demonstration partners and microgrid equipment manufacturers

Technology Transfer, Collaborations, and Partnerships

Visitors to AEP Dolan Test Laboratory since 2009

Hawaiian Electric + Texas A&M
Raytheon Microgrid
Ohio House Committee on Alternate Energy
KEMA + CPFL (Brazil)
Tokyo Electric
UCAIug OpenSG - 80 utility members
International Microgrid Consortium tour group
State Grid of China
Ohio Green Energy Open House
Tokyo Electric
Eisenhower Fellows
Arts Impact Middle School
Consert EMS Tour
HD Supply Tour
Battelle RTP Team
Energy Conversion Devices
Kyushu Electric and Hitachi
GE Energy
Cooper Power Systems
Energy Conversion Devices + Ovonics
Rexorce Waste Heat Recovery
Panasonic Home Energy Manager Team
Chevron
EPRI Intelligrid meeting - 50 members from various utilities
Ohio State Student Group
AEP Coop Students
University of Michigan Group
Columbus State University
Chung Yuan Christian University
Ohio Secretary of State

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